from the island of Cyprus; a species closely allied to the former, from Asia Minor; *M. orientalis*, Gmel., from Northern Persia; *M. Vignei*, Blyth, from Chorosan; *M. arkal*, Br., from Turcomania; and *M. Burchelli*, Blyth, from the Himalayas.

This genus, in the shape of the horns, shows an approach to the goats; and the above-named species of *Ammotragus* and *Ægoceros* are closely allied to it. The former, being built like a sheep and having horns exactly like *Musimon cyprius*, wants the lacrymal fossæ of the goats in front of the orbit in consequence of the small development of that bone; there is also no ridge on the nose. The only species inhabiting Africa is the *tragelaphus*. The latter, besides the want of the lacrymal fossæ, differs also in its structure, being built like a goat, in the short skull and the beard which is found on male specimens; in the shape of the horns only does it resemble *Musimon*. These latter are almost smooth, in which this form differs from the sheep as well as from the goats; it is the Caucasian species *Æ. Pallasii*, Rouill. Another species, which also possesses a beard and ovine horns, occurs in Cabul (Journ. Asiat. Soc. of Bengal, 1840, p. 440; Wagn. Fortsetz. v. Schreb. 1844, Suppl. iv. p. 540, note).

Having in this way fixed (by help of comparative diagnosis) the position of the Turkestan sheep in systematic classification, I think it will be well to state their specific differences before going on to their more detailed description.

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 9, 1876.—Dr. Günther, M.A., Vice-President, in the Chair.

"On the Development of the Crustacean Embryo, and the Variations of Form exhibited in the Larvæ of 38 Genera of Podophthalmia." By C. Spence Bate, F.R.S.

The author states that, although the general forms of several genera of Podophthalmous Crustacea are known, yet the details of their structure have been so unsatisfactorily figured and described, that the value and importance of hereditary elements are incapable of being studied and appreciated.

Through Dr. Carpenter he received from Mr. Power an offer of a considerable number of larvæ of exotic species, together with

the parents from which they had been obtained; in relation to which Mr. Power wrote:—

"Dear Sir,—I have to thank you for your kindness in answering my letter to Dr. Carpenter, and for the memoirs.

"My collection of Crustacea and the microscope-slides of the larvæ are at present, and have been, packed up in Fort Louis. Now I am again on detachment; and if left here in peace for a few months, I shall arrange my specimens and finish up the microscopic drawings.

"All my larvæ are hatched in basins (the only kind of aquaria my nomad life allows me to use); so each crab or prawn &c. whose larvæ I possess is identified with its young. And this reminds me that on reading Fritz Müller's paper in the 'Annals' (1864, vol. xiv. p. 104), I was much astonished, as none of the prawns or prawn-allies whose young I have hatched show any such *Nauplius* form as shown in figures 1 & 3, &c., but all I have observed as yet are born like fig. 8, or near it.

"I have been quite unable to rear any crab-larvæ beyond a day or two after birth; whether they require moving water or not I do not know; but certainly, though I have kept the parents alive for several weeks in basins (the water changed once or twice in 24 hours) of salt water, the same method would not succeed with the larvæ. I then tried small aquaria, and signally failed again.

"I have not been in the neighbourhood of fresh water as yet, so have had no opportunities of observing the freshwater Crustacea, though there are a good many crab and shrimp forms. I have found two kinds of that curious parasitic crustacean which adheres like a little polypus, a mere bag with a peduncle, but containing hundreds of young Crustacea whose genus I do not know, as I cannot find any account of them in Van der Hoeven's 'Zoology'*.

"If I succeed in getting posted to one of the regiments here, my life will be more stationary, and I shall have far better chances of working my crab-hatchings.

"In Fritz Müller's paper before referred to, I fancy that he has not hatched the different larvæ mentioned. After reading the paper very carefully, I could not help fancying that the various stages of development were not hatched through, but specimens were captured at different times, and perhaps larvæ of totally different species have been given as stages of the same animal. I say this with great doubt; but reading the paper will, I think, bring every one to the same conclusion. Thus he says, 'the unaltered *Nauplius* form, probably the same in which the animal escapes from the egg, came under notice only once;' again, 'This larva (taken on the 13th of January) is closely approached by four others, probably *belonging* to the same swarm, which were taken at the same time (24th January);' and so on.

"To tow a net in these tropical seas and to examine all the microscopic Crustacea would give a most extraordinary assemblage

[* New genus allied to *Sacculina*, which hatch larvæ in the cirriped pupa stage.—C. S. B.]

of forms ; but I doubt if it is so useful as tracing the steps of individuals. * * * * * *

"I have not yet hatched the land Hermit-crabs, though I suppose they are much as the ordinary sea specimens, and they certainly spend their larval life in the sea.

"Pray excuse my rambling letter, and please let me know of any way in which I can be of any use to you in my humble dips into natural history. "Yours very truly,

"Wilmot Henry Power,
"*Staff-Surgeon, 44th Regt., Lt. Inf.*"

Some time afterwards the author received the promised collection, together with Mr. Power's drawings and notes. These have enabled him to identify the parent forms of some known larvæ, and also to determine those of several unknown genera.

It has also led him to the conviction of a unity of character throughout the various forms and changes of Crustacea; that variety in form is never inconsistent with homological truth ; that parts suppressed or rendered abortive for want of use are never absolutely lost, and may be reproduced under conditions that may require them.

The eyes of those Crustacea, such as *Alpheus*, that inhabit dark places are reduced in power according to the condition of their habitat. But these organs are, in their larval state, as well developed, if not more so, as any of those whose life is passed in the bright sunshine of the surface of the ocean.

The blind *Didamia* brought from the depth of four miles below the surface of the Atlantic by the dredges of the 'Challenger' differs in no respect from *Polycheles*, taken by Heller in the comparatively shallow Adriatic sea. In the blind prawn from the Mammoth Cave of America, and the sightless *Nephrops* of Formosa, the organs of vision are reduced to the smallest condition consistent with their retention; and in the Cirripedes the eyes are represented by their nervous apparatus only.

The several forms of larva have not, in the prawn-allies, shown any approach to the *Nauplius* state, as mentioned by Fritz Müller; so that the author believes that it must be confined to the genus *Peneus* alone among the Podophthalmia. Nor should it be forgotten that the *Nauplius* form has only been observed as a free-swimming animal.

The author has taken this opportunity of making a close examination into the earlier stages in the development of the embryo, and comparing the progress within the ovum of some of the larvæ that arrive at or near maturity before being hatched, with those of the larval forms that are hatched in a more immature condition ; and he states that, as soon as the protoplasm assumes any thing like a definite plan, distinct lobes, corresponding in position with those of the several appendages in the *Nauplius*, together with an embryonic or ocular spot, are present—that in the *Nauplius* forms they exist as deciduous appendages only, and are soon cast aside and replaced by others more adapted to the wants of the adult existence.

In the embryos of other Crustacea the anterior pair of lobes enlarge in size with little alteration of form, while the posterior two pairs are developed into appendages that have but a deciduous value, since they never fulfil the office of permanent organs, and are generally cast off with an early moult.

This is observable within the ovum in *Palæmon*, *Crangon*, &c., and also in the marsupial embryo of *Mysis* after it has quitted the ovum.

The relation of these parts to the permanent organs the author has closely traced, and believes that he has demonstrated that the three pairs of mobile appendages in the cirripedal or *Nauplius* form of larva homologize with the eyes and two pairs of antennæ, and not with the antennæ and mandibles, as stated by Fritz Müller, Anton Dohrn, and others.

The author, moreover, contends that the small pair of filamentary appendages seen on each side of the ocular spot, existing in the *Nauplii* of Cirripedes, homologize with the peduncular appendage existing in the larva of *Caligus*, the arm-like appendages in the pupa-stage of Cirripedes, the peduncle of the stalked Cirripedes, and probably also with the long multiarticulate, antenna-like organs belonging to the fossil *Pterygotus*.

He also demonstrates the origin of the nerves in a mass of cellular material that reaches from one extremity of the embryo to the other. This divides into parts corresponding to the various somites into which the animal divides. These masses gradually separate from each other as the animal increases in size, and concentrate into the several ganglia that form the great nervous chain.

The author also shows the origin of the permanent organs of vision, and the manner in which the number of lenses increases with the growth of the animal, and traces the origin of several of the internal viscera and their mode of growth.

He also figures, in minute detail, the larvæ of the following genera (those in *italics* are from British specimens, while all the others are from the collection sent to him by Mr. Power):—

Palæmon fluvialis, n. sp.
—— *squilla*, Leach.
Crangon vulgaris, Leach.
Hymenocera, *Heller*.
Alpheus obesimanus, *Dana*.
Homaralpheus, n. g.
Homarus marinus, Leach.
Palinurus vulgaris.
Astacus fluviatilis.
Squilla.
Porcellana rugosa.
—— *longicornis*.
Galathea.
Pagurus tibicen.
—— elegans.
—— Bernhardus.
Clibinarus
Trichia.
Gelasimus.
Cyclograpsus.
Libinia.
Menæthius.
Stenorhynchus.
Mithrax.
Trapezia pectinata.
—— ferruginea.
Pilumnus.
Melia tessellata.
Carpelodes rugipes.
Actinurus setifer.
Xantho Lamarckii.
Actæa obesa.
Thia ?
Liomera.
Pirimela ?
Thalamita.
Achelous.
Euriphia.
Thalassina.
Carcinoecystus, n. g.

April 6, 1876.—Dr. J. Dalton Hooker, C.B., President, in the Chair.

"On the Structure of a Species of *Millepora* occurring at Tahiti, Society Islands." By H. N. Moseley, Naturalist to the 'Challenger' Expedition.

In a paper treating mainly of the structure of *Heliopora cærulea*, communicated to the Royal Society in the autumn of 1875, some account was given of results arrived at from the examination of two species of *Millepora* obtained at Bermuda and at Zamboangan, Philippines; and in that paper a summary of the literature concerning the tabulate corals generally was given. The present paper, to be considered to a certain extent a continuation of the last, gives an account of the structure of a species of *Millepora* obtained at Tahiti, Society Islands. The author commences by expressing his obligations to his colleague Mr. J. Murray, who obtained living specimens of the *Millepora* and handed them over to him with the zooids in the expanded condition for examination, and who further, having devoted some time to the study of the coral, gave him valuable information with regard to several points in its structure.

No *Millepora* appears to have been hitherto known to occur at Tahiti. The name of the species of the one the structure of which is described in the paper was not ascertained. It resembles *M. tuberculosa*, as described by Milne-Edwards*, in outward form, but differs from it in having the calicles of two kinds disposed on the surface of the corallum in regular separate systems, in this respect resembling more closely *M. plicata*, *M. foliata*, and *M. Ehrenbergii* as described by the same author.

The coral was examined in the fresh condition, and also preserved in alcohol, chromic acid, and glycerine, and treated with osmic acid. Hardened specimens were decalcified and examined by means of sections. The corallum is a spongy mass composed of more or less contorted trabeculæ of calcareous matter, which is disposed in a series of thin layers following the contours of the surface, and representing successive additions by growth. Within these layers ramify a series of canals which give off branches and subbranches, the whole ramifications being intimately connected with one another, and with the calicular cavities, by a network of smaller channels. The main canals are sometimes large enough to be easily seen by the naked eye, and run for as great a distance on the surface of the corallum as $1\frac{1}{2}$ inch. This system of branching canals is held to be characteristic of the coralla formed by the hydroid genus *Millepora*, distinguishing it from all other coralla. The calicles are of two kinds, small and large. They are disposed on the surface of the corallum in irregularly circular systems. A large calicle occupies the centre of each system, and is surrounded by a ring of smaller calicles, usually from five

* Hist. Nat. des Coralliaires, pl. F 3. figs. 1*a*, 1*b*.

to eight in number. In histological structure, as also in chemical composition *, the coralla of the genus *Millepora* seem to show no marked differences from Anthozoan coralla.

The zooids are of two kinds. The one, short and stout, occupies the larger central calicles of the systems, has from four to six short knobbed tentacles, and is provided with a mouth and certain gastric cells, closely resembling those figured by Allman as occurring in *Gemmaria implexa* †. The other kind occupies the smaller calicles, is longer and more slender than the mouthed zooid, has from five to twenty tentacles, and no trace of a mouth. The usual number of tentacles in the mouthless zooid is about twelve to fifteen. The tentacles are larger than in the mouthed zooid, and disposed at irregular intervals along the body. They show the transverse striation, or apparent septa, so characteristic of the tentacles of hydroids. They have spheroidal heads composed of masses of thread-cells.

The zooids of both kinds are provided with well-marked longitudinal muscular fibres, which are disposed in bundles, and are attached inferiorly to the vessels of the hydrophyton which join the somatic cavity at the base of the zooids. Circular muscular fibres are possibly also present. As in *Heliopora*, only a thin layer at the surface of the coral is living.

The soft parts of the hydrophyton consist of a network of canals and vessels occupying the corresponding canals in the corallum. The canals are composed of an ectoderm and an endoderm. The ectoderm rests on a thin layer of membrane. It is mainly composed of fusiform finely granular cells with an oval nucleus, but is much modified in certain regions. In the upper part of the living layer its cells are abundantly converted into the parent cells of thread-cells, and on the actual surface into a layer of prismatic cells showing at the very surface hexagonal outlines. This layer is believed to be continuous over the whole outer surface of the coral. It is continued down into the calicular cavities, and in the contracted condition almost closes their orifices. The endoderm consists of two elements—yellow pigmented cells closely similar to those of other hydroids, and small transparent highly refracting globules. The pigmented cells are abundant in the somatic cavities of the zooids, and in the canals and vessels of the hydrophyton. They impart a bright yellow colour to the tips of the tubercles of the living coral. The canal-system of the hydrophyton anastomoses most freely with the somatic cavities of the zooids, and establishes a free communication between them. Two kinds of thread-cells are present. The one is of the peculiar form occurring only in Hydrozoa, viz. that which has in the expanded condition a short, wide, bladder-like structure at the base of the thread next

* Structure and Classification of Zoophytes, by J. D. Dana (Philadelphia, 1846), Appendix, p. 130. Corals and Coral Islands, *ejusd.* (London, 1872), p. 105.

† Gymnoblastic and Tubularian Hydroids, pl. viii. fig. 5.

the cell, which bladder is armed with three spines set in one whorl. In *Millepora* the spines are unusually long and set at right angles to the thread. This kind of thread-cell alone occurs in the tentacles; it occurs also more sparingly in the hydrophyton.

The other kind of thread-cell is larger and ovoidal in form, closely resembling that figured by Allman as occurring in *Gemmaria implexa*. These thread-cells are confined to the hydrophyton. They form densely set zones around the bases of the zooids.

The other species of *Millepora* examined appear to agree in all essential particulars with that occurring at Tahiti. They have mouthed and mouthless zooids, but these are not arranged in regular systems. They have the same two kinds of thread-cells, with a similar distribution. The Tahitian *Millepora*, like the others examined, is infested by a parasitic fungus, which exists in the soft superficial tissues, as well as in the substance of the corallum, and has a decided green tint.

GEOLOGICAL SOCIETY.

March 22, 1876.—Professor P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On the Triassic Strata which are exposed in the Cliff Sections near Sidmouth, and a note on the occurrence of an Ossiferous Zone containing Bones of a *Labyrinthodon*." By H. J. Johnston Lavis, Esq., F.G.S.

The author described the base of the cliffs east of Sidmouth as composed of the Marl which is the uppermost subdivision of the Trias in South Devon, capped in Littlecomb Hill and Dunscomb Hill by Greensand and Chalk, and in Salcombe Hill by Greensand alone. In the valley of the Sid it is largely exposed at the surface. Close to the mouth of the Sid the Upper Sandstone crops out beneath the marl, forming a cliff overhanging the river. To the west of Sidmouth there is a low projecting cliff, the Chit rock, formed also of the Upper Sandstone; and at the western end of this is a fault which has given the Chit rock an upthrow of at least 40 and perhaps of 80 feet, since it has no marl capping it, and in its lithological character it resembles the middle part of the Upper Sandstone. To this point the dip is to the east; but westward of the fault the dip is at first to the west for about half a mile, when the sandstone reappears with an easterly dip, having formed a synclinal curve. It is overlain by Marl and Greensand in Peake and High-Peake Hills, which are capped with Chalk gravels. West of High-Peake Hill the Sandstone forms the whole cliff. The author described the general characters presented by the Triassic beds in the section under notice, and mentioned the occurrence at about 10 feet from the top of the Sandstone of a peculiar series of beds, composed of coarse sandstone, containing scattered nodules of marl from the size of a pea to that of a hen's egg, together with numerous